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[54] Pneumatic tire

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Specification

1. Title of Invention

Pneumatic tire.

2. Scope of Patent Claim

A pneumatic tire in which the tread rubber is blended rubber consisting of 5~200 weight parts of at least one type of diene based rubber (B) selected from the group comprising natural rubber, polyisoprene rubber, styrene-butadiene rubber or cis-1,4-polybutadiene rubber to 100 weight parts of (A), polybutadiene with 60~90 wt.% of trans-1,4-bonds and no more than 10 wt.% of 1,2-bonds, said tire characterized by the fact that the groove area ratio of the tread section to the entire contact area is 30~50%.

3. Detailed Description of the Invention

[Field of Industrial Utilization]

This invention concerns a pneumatic tire with outstanding braking performance on wet roads at high speeds and chipping resistance. Specifically, it concerns a pneumatic tire for passenger cars.

[Conventional Techniques]

The performance of vehicles has improved in recent years, and the use of special high performance vehicles or four-wheel drive vehicles has spread.

High braking performance on wet roads at high speeds and high chipping resistance of tires has been called for in such vehicles.

The use of tread rubber combining styrene-butadiene copolymer rubber with a high styrene content and butyl rubber has been practiced as means of improving the braking performance on wet roads (Patent Publication No. 14581-1969).

However, the tread blending such rubber has had the problem of reduction of braking performance on icy roads in the winter.

Moreover, the method of arranging water discharge grooves in the circumferential direction of the tire tread using tread rubber with low heating properties and inferior braking performance on wet roads has also been practiced (Patent Disclosure No. 69101-1977, Patent Publication No. 18248-1983).

Accordingly, the tread pattern would be a block shape, and the tread rubber when contact is made would be prone to deformation.

In addition, compositions blending specific carbon black in blended rubber with trans-1,4-polybutadiene and cis-1,4-polyisoprene have been used in tread rubber (Patent Disclosure No. 133036-1985). While such rubber compositions have outstanding braking performance on icy roads, the braking performance on wet roads in pneumatic tires with great groove areas in the tread pattern has been inferior, which is a problem.

[Objective of Invention]

The objective of this invention is to provide a been with outstanding braking performance and chipping resistance on wet roads at high speeds, thereby eliminating the aforementioned defects of conventional technology.

[Composition f Invention]

The pneumatic tire of this invention which attains the aforementioned objectives is one in which the tread rubber is blended rubber consisting of 5~200 weight parts of at least one type of diene based rubber (B) selected from the group comprising natural rubber, polyisoprene rubber, styrene-butadiene rubber or cis-1,4-polybutadiene rubber to 100 weight parts of (A), polybutadiene with 60~90 wt.% of trans-1,4-bonds and no more than 10 wt.% of 1,2-bonds. This tire is characterized by the fact that the groove area ratio of the tread section to the entire contact area is 30~50%.

This invention is explained in detail below.

The polybutadiene (A) used in this invention must have 60~90 wt.% of trans-1,4 bonds and no more than 10 wt.% of 1,2 bonds (vinyl bonds).

The cut-chipping resistance is reduced when the amount of trans-1,4 bonds falls below 60 wt.%, while production becomes extremely difficult when the amount of trans-1,4-polybutadiene exceeds 90 wt.%, and this is uneconomical. The most desirable range is 70~80 wt.%.

In addition, the rubber itself becomes prone to heating when the amount of 1,2-bonds exceeds 10 wt.%. Thus, a level of no more than 8 wt.% is desirable.

The polybutadiene (A) can be produced by solution polymerization of butadiene in the presence of a compound catalyst such as Ba compound/organic Li compound. Emulsion polymerization would also be possible, but alteration of the microstructure of the butadiene section is difficult in emulsion polymerization, and it is difficult to hold the amount of 1,2-bonds (vinyl bonds) below 10 wt.%. Thus, this method is undesirable.

The diene-based rubber (B) used in this invention is selected from the group comprising natural rubber, polyisoprene rubber, styrene-butadiene rubber, cis-1,4-polybutadiene and high styrene-butadiene rubber.

The blending ratio of polybutadiene (A) to diene-based rubber (B) in this invention must be 5~2000 weight parts of diene-based rubber (B) to 100 weight parts of polybutadiene (A). The braking performance on wet roads and the improvement in chipping resistance are too low when less than 5 weight parts of diene-based rubber (B) are used. Thus, the objectives of this invention are not attained.

This invention uses the aforementioned blended rubber as the tread rubber, and a pattern must be formed in which the groove area ratio of the tread section of the tire to the entire contact area is 30~50%. The groove area and the contact area of the tread section are measured pursuant to JIS using the contact shape with standard pneumatic pressure and standard load. The ratio of the contact area to the groove area is then determined.

The braking performance at high speeds on wet roads is reduced when the groove area ratio falls below 30%, and the tire cannot perform as a high performance tire, as a tire for four-wheel drive vehicles or as an all-season tire. Moreover, the contact pressure of the tread surface becomes too great when the groove area ratio exceeds 50%, and the abrasion life of the tire is reduced, which is impractical.

This invention is explained concretely below through actual examples.

Polybutadiene with two types of microstructure was used, as illustrated in Table 1 below.

Table 1

Type of polybutadiene	BR-1	BR-2
Cis-1,4 bond weight (%)	98	25.1
Trans-1,4-bond weight (%)	1	70.2
1,2-bond (vinyl) bond weight (%)	1	4.7

The microstructure of the butadiene section was measured by IR.

In addition, the BR-1 was "Nipol" 1220 (product of Nihon Zeon Co.).

Using the polybutadiene BR-1 and BR-2 of Table 1, 30 weight parts of polybutadiene, 70 weight parts of styrene-butadiene copolymer rubber, 70 weight parts of HAF-HS carbon black, 2 weight parts of stearic acid, 40 weight parts of aromatic oil, 2 weight parts of sulfur and 1.2 weight parts of vulcanization accelerator OBS were blended using a Bumbury's mixer and open roll. This was used to produce the tread rubber of a 195/60HR14 tire illustrated in Table 2 below. The chipping resistance test results are also illustrated. The chipping resistance was evaluated after observing the mode of rubber disintegration of the tread surface.

Table 2

Tire	T-1 Comp. Ex. 1	T-2 Comp. Ex. 2	T-3 Comp. Ex. 3
Groove area ratio (%)	20	40	40
Styrene-butadiene copolymer rubber (phr)	70	70	70
BR-1 (phr)	30	30	0
BR-2 (phr)	0	0	30
Chipping resistance	Good	Poor	Good

A wet road was created by sprinkling water on a test course of the Japan Automobile Road Research Center, and the coefficients of friction of tires T-1, T-2 and T-3 illustrated in Table 2 were measured at speeds of 20~80 km/h. Figure 1 illustrates the results.

The results of Tables 1 and 2 and of Figure 1 reveal the following.

The tire T-1 (Comparative Example 1) uses polybutadiene in which the trans-1,4-bond amount is very low, at 1%, and the groove area ratio is only 20%. As a result, the coefficient of friction on wet roads, especially the braking performance at high speeds, is poor although the chipping resistance is good.

Tire T-2 (Comparative Example 2) also uses polybutadiene in which the trans-1,4-bond weight is low, and the groove area ratio has been improved to 40%, but the chipping resistance remains poor and the coefficient of friction on wet roads is poor at low speeds.

In contrast, tire T-3 (Actual Example) uses polybutadiene in which the trans-1,4-bond weight is 70.2 wt.%. The chipping resistance is good since the groove area ratio has been set at 40%, and the coefficient of friction on wet roads is also increased, especially at high speeds.

[Effects of Invention]

This invention provides outstanding chipping resistance and high speed braking performance on wet roads in a tire which uses blended rubber comprising polybutadiene with a high trans-1,4-bond amount and diene-based rubber in the tread section, a tire in which a specific groove area ratio has been set.

4. Brief Description of Drawings

Figure 1 is a graph illustrating the relation between the running speed of a tire and the coefficient of friction on a wet road.

T-1.. tire of Comparative Example 1, T-2.. tire of Comparative Example 2, T-3.. tire f Actual Example.

Figure 1